

## REMARKS

Claims 1-3, 5-7, 10, 11 and 13-20 are pending in the present Application.

Claim 6 has been amended to recite the step of maintaining the concentration of the compound having the  $-X-S-$  structure at equal to or less than 2.0 micro mol/L. Support for this is found in the Specification at page 9, lines 15-25.

The Specification has been objected to because of the references to Fig. 1 and Fig. 2 on page 21. Applicants submit that the present amendment to the Specification makes this objection moot. Applicants respectfully request that this objection be withdrawn.

Claim 10 has been objected to because of the use of the word “comprising” in line 14. Applicants submit that the present amendment moots this objection and respectfully request that this objection be withdrawn.

Claims 1-3, 5-7, 10-11 and 13-20 have been rejected under 35 USC § 112, second paragraph, as being indefinite for failing to point out particularly and claim distinctly the subject matter which Applicants regard as their invention. Applicants respectfully traverse.

The MPEP § 2173.05(h) states that alternative Markush expressions using “or” are acceptable. It does not say that such expressions *require* the use of the word “or”. However, Applicants have so amended the claims in the interest of furthering prosecution.

The Official Action at pages 13 and 14, indicates that in line 18 of claims 2 and 11 that the first occurrence of “and” should be changed to “or”. Applicants respectfully disagree. Lines 17-18 of claims 2 and 11 contain the phrase “. . . an acyclic or cyclic amine compound containing 1 to 6 nitrogen atoms, 1 to 20 carbon atoms, and a plurality of hydrogen atoms; . . .” It is clear that the acyclic or cyclic amine compounds is composed of 1 to 6 nitrogen atoms and 1 to 20 carbon atoms and a plurality of hydrogen atoms. The use of the word “or” is improper here. Likewise, lines 18-19 of claims 2 and 11 contain the phrase “. . . a heterocyclic compound containing 1 to 2 sulfur atoms, 1 to 6 nitrogen atoms, 1 to 20 carbon atoms, and a plurality of hydrogen atoms.” It is clear that the heterocyclic compound is composed of 1 to 2 sulfur atoms

and 1 to 6 nitrogen atoms and 1 to 20 carbon atoms and a plurality of hydrogen atoms. Accordingly, the use of the word “or” is improper here.

At page 14, the Official Action states that in line 6 of claim 10, the use of the word “and” is improper. Applicants respectfully point out that the word “and” in line 6 is part of a Markush expression and is therefore proper.

Applicants respectfully request that this rejection be withdrawn.

Claims 1-3, 5-7, 13, 15, 16, 18 and 20 have been rejected under 35 USC § 103(a) as being unpatentable over Eckles (U.S. 4,384,930) in combination with Okinaka et al. (U.S. 4,469,564). Applicants respectfully traverse.

Applicants’ invention as claimed in claim 1 is directed to a copper plating bath, and method using such bath, comprising copper, water, a water-soluble chlorine compound, a brightening agent compound represented by the formula  $-X-S-Y-$ , and a thiol-reactive compound chosen from peroxy acids and certain carboxylic acids. Thus, Applicants’ copper plating bath *requires* both a brightening agent compound and a certain thiol-reactive compound. Applicants’ claimed invention provides copper-filled vias. In particular, Applicants’ thiol-reactive compounds control the presence of  $-X-S^-$  compounds resulting from the use of these polysulfide compounds as brightening agents. Such  $-X-S^-$  compounds lead to a deterioration in the via-filling property of the copper plating solution and in the appearance of the plated deposit.

Eckles is directed to an electroplating bath containing at least one surfactant of a given formula, such surfactants providing bright and level metal deposits. Such electroplating bath may contain a brightening compound, and such brightening compounds are typically “carbonyl-containing compounds which may be either aromatic carbonyl-containing compounds or aliphatic carbonyl-containing compounds.” Such carbonyl-containing compounds are “aldehydes, ketones and carboxylic acids”. See column 5, lines 7-13. The certain carboxylic acids claimed by Applicants are neither taught nor suggested by Eckles. This patent does not disclose or suggest brightening agents of the formula  $-X-S-Y-$  as required by the present claims.

The Okinaka et al. patent discloses a copper electroplating bath containing certain

polysulfide compounds as ductility increasers. This patent neither teaches nor suggests the use of the particular thiol-reactive compounds required by Applicants' claims. Accordingly, this patent neither teaches nor suggests the use of Applicants' claimed thiol-reactive compounds with polysulfide compounds in an electroplating bath.

There is no motivation to combine these references. Regarding such motivation, the official action states at page 6: "In this case, the combination is in the knowledge generally available to one of ordinary skill in the art." Applicants submit that such a conclusory statement is insufficient motivation to combine these references. Motivation to combine references must be articulated and placed on the record. See *In re Lee*, 277 F.3d 1338; 61 U.S.P.Q.2D 1430, 1435 (Fed. Cir. 2002).

Even if one were to combine these references, there is nothing in Eckles or Okinaka alone or in combination, that teaches or suggests the electroplating bath containing the particular thiol-reactive compounds claimed by Applicants. In particular, nothing in these references teaches or suggests a process for filling vias in a substrate by contacting the substrate with the claimed electroplating bath and maintaining a concentration of  $-X-S^-$  compounds at or below a certain level.

Applicants submit that the Examiner has not made out a *prima facie* case of obviousness and respectfully request that this rejection be withdrawn.

Claims 14 and 17 have been rejected under 35 USC §103(a) as being unpatentable over Eckles (US 4,384,930) in combination with Okinaka et al. (US 4,469,564) and further in view of Uzoh et al. (US 6,355,153). Applicants respectfully traverse.

Applicants claims 14 and 17 are directed to a certain peroxo acids as the thiol-reactive compound. One skilled in the art reading the peracids of claims 14 and 17 would know these are compounds having the general formula  $RC(=O)-O-O-H$ .

Eckles and Okinaka et al. are discussed above, both individually and in combination.

Uzoh et al. is directed to chip interconnect and packaging methods in which portions of a seed layer are selectively removed from the top surface of a substrate and a conductive material is

deposited in the cavities of the substrate. The conductive material is deposited from a plating bath which may contain a metal oxidizing agent. The *only* metal oxidizing agents disclosed are inorganic and organic *peroxides*, persulfates, nitrates, nitrites, thiosulfates, salts of nitrobenzene sulfonates.

In discussing Applicants' prior argument regarding motivation to combine these references, the official action states at page 6: "In this case, the combination is in the knowledge generally available to one of ordinary skill in the art." Applicants submit that such a conclusory statement is insufficient motivation to combine these references. Motivation to combine references must be articulated and placed on the record. See *In re Lee*, 277 F.3d 1338; 61 U.S.P.Q.2D 1430, 1435 (Fed. Cir. 2002).

Even if one were to combine these references, the Uzoh patent does not fill the deficiencies of Eckles and Okinaka. The Uzoh patent neither discloses nor suggests peroxy acids. The *peroxides* disclosed in Uzoh are different from the peroxy acids claimed by Applicants. Nothing in the Uzoh patent suggests any equivalence between inorganic or organic peroxides and Applicants' claimed peroxy acids. Thus, there is nothing in Uzoh to suggest Applicants specifically claimed peroxyacids.

Applicants submit that the Examiner has not made out a *prima facie* case of obviousness and respectfully request that this rejection be withdrawn.

Applicants respectfully request favorable reconsideration in the form of a notice of allowance.

Respectfully submitted,



S. Matthew Cairns, Ph.D.  
Attorney for Applicant  
Registration No. 42,378

EDWARDS & ANGELL LLP  
PO Box 55874  
Boston, MA 02205  
Date: